A UNIQUE RAISED BOG AT URBANA, OHIO.*

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Located just north of the Champaign County Fair Grounds at Urbana, Ohio, is a unique dome-shaped bog, covered with shrubby vegetation for the most part, in which the center is raised at least ten feet above the margins. An old road crosses the bog. I have been told that it was once the main thorofare from Urbana to Columbus. Horses and wagons passed over it, I suppose, the drivers never realizing that a mat of fibrous roots less than one foot thick was all that held them over a body of water twelve feet in depth.

Raised bogs, called "high moors" and "Hochmoore" in foreign literature, have long been known throughout Europe. N. S. Shaler is credited by Nichols with being the first to call attention to these peculiar swamps in North America, in 1888–89. Those which Shaler observed were "mostly limited to the eastern portion of Maine, near the shores of the Bay of Fundy," but some of lesser magnitude were reported for New Hampshire, northern Michigan, and Minnesota. Similar bogs, with centers about 13 feet above their margins, have been reported in the province of New Brunswick by Ganong (1897).

Nichols (1919) described bogs of this type encountered in Maine, in which the elevation of the center above the margin varied from 2 or 3 feet to as high as 18 feet (e. g., Denbo Heath, covering several square miles in area). He asserts: "(1) that in the state of Maine raised bogs, in so far as they constitute a distinctive swamp type, are virtually restricted to the proximity of the seacoast; and (2) that in other portions of New England and of the eastern United States this type of bog is practically absent, although in occasional swamps it is possible to detect a slight elevation of the surface above the level of permanent ground water."

Warming (1909) has summarized concisely the characteristic features of "Hochmoore." They owe their development to the growth of sphagnum mosses which absorb water that falls in the form of rain or snow. Accordingly they are confined to

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regions of high precipitation and high humidity. They are called raised bogs or climbing bogs because they are commonly much higher near their centers than at their margins. According to Warming, their waters are practically free from salts or lime, and they are covered with bog mosses, chiefly species of *Sphagnum*, and with shrubby heaths. Nowhere in the literature can we find a reference to raised bogs in which the water contains an abundance of calcium salts and in which the dominant vegetation is other than sphagnum mosses and shrubby heaths, but such is the Urbana bog.

The presence of this unique habitat was first brought to the writer's attention in June, 1926, by Mr. Roscoe Franks, who realized its unusual character. It has lately been visited many times, in company with other botanists and classes from the Ohio State University.

The main portion of the bog occupies a lot eight or ten acres in extent, belonging to the McDonald Sisters in Urbana. Water which flows from the bog and from springs in the vicinity is used by the Urbana Tool and Die Co. to supply their reservoir, less than a quarter of a mile to the west. The water is distinctly alkaline, and the streams are usually choked with species of *Chara* and with watercress (*Radicula nasturtium-aquaticum* (L.) Britt. & Rendle. *Zannichellia palustris* L. and *Batrachium circinatum* (Sibth.) Rchb. occur in the streams and ditches, along with filamentous algae, which are being studied by F. B. Chapman. The coldest waters issuing from the bog on July 24, 1932, were at a temperature of 55° F., according to Chapman's data.

The dominant vegetation over the raised bog consists of a dense growth of shrubby cinquefoil (*Dasiphora fruticosa* (L.) Rydb.) Elderberry bushes (*Sambucus canadensis* L.) are scattered among the smaller shrubs, but are not nearly so numerous as the cinquefoils. Swamp rose (*Rosa carolina* L.) is also an important member of the plant association on the bog. Tufts of sedges, (principally *Carex emoryi* Dew.) grow everywhere on hummocks created by the crowns of shrubby cinquefoil. In some places, which are better drained, the sedges are replaced by Kentucky blue grass (*Poa pratensis* L.). Purple-stemmed Angelica (*Angelica atropurpurea* L.), swamp-milkweed (*Asclepias incarnata* L.), and evening primrose (*Oenothera biennis* L.) are perhaps the commonest large herbaceous plants and grow luxuriantly in this bog habitat.

FIG. 1. (Upper.) Stream choked with water-cress in June, 1926.
Urbana Raised Bog.
FIG. 2. (Lower.) A view of the raised bog at Urbana, Ohio, October 7, 1931.

On the black peaty soil underneath the shrubs are small herbaceous plants, including crested shield-fern (*Dryopteris cristata* (L.) Gr.) small-flowered agrimony (*Agrimonia parviflora* Ait.) and several kinds of bryophytes and lichens. Two species of mosses have been identified by C. H. Coles as *Anomodon rostratus* (Hedw.) Schimp. and *Tortella caespitosa* (Schwaeg.) Linn. No sphagnum has been found here.

A preliminary traverse of the bog has been made by J. C. Kuenzel and O. D. Diller of the Central States Forest Experiment Station staff. The margins of the bog have an elevation of approximately 1050 feet above sea level, while the datum for the highest point is 1061. A few yards to the north of this point, a water-pipe has been driven into the peat. Although the top of the pipe is at least one foot above the ground, a steady flow of clear cold water flows out of the top, showing that a head of water pressure is maintained beneath the bog.

Test borings have been made by E. M. West, now Assistant Professor of Botany at Louisiana State University. A boring at the 1060-foot contour shows that 12 feet of water lies beneath the dense mat of roots which permeate the soil. It was there that the old road, previously referred to, crossed the bog. The road was formed by spreading gravel over the black peaty soil and is now marked by a luxuriant growth of blue-grass. Other introduced plants have been seen, including an apple tree, a peach tree, a few osage orange trees and a clump of *Ornithogalum umbellatum* L. A single specimen each of "buffalo currant" (*Ribes odoratum* Wendl.) and Japanese barberry (*Berberis thunbergii* D.C.) grow beside the old road bed.

Comparatively few boreal relics of the Northern Evergreen Forest Center are present in the bog flora. They include the following species:

Dasiphora fruticosa (L.) Rydb. (*Potentilla fruticosa* L.)
Carex emoryi Dew.
Galium boreale L.
Vagnera stellata (L.) Mor.
Anticlea elegans (Pursh.) Rydb.

Many species, characteristic of marshy areas in general of the northeastern states and Canada, are included, as follows:

Dryopteris thelypteris (L.) Gr.
Dryopteris cristata (L.) Gr.
Onoclea sensibilis L.
Glyceria nervata (Willd.) Trin.
Typha latifolia L.
Caltha palustris L.
Carex hystricina Muhl.
Carex lurida Wahl.
Scirpus validus Vahl.
Scirpus americanus Pers.
Scirpus atrovirens Muhl.
Rosa carolina L.

Rumex britannica L.
Alsine longifolia (Muhl.) Britt.
Lythrum alatum Pursh.
Solanum dulcamara L.
Salix discolor Muhl.
Dracocephalum virginianum L.
Pedicularis lanceolata Mx.
Eupatorum purpureum L.
Cirsium muticum Mx.
Viola papilionacea Pursh.
Impatiens biflora Walt.
Galium tinctorium L.
Urtica dioica L.
Lycopus americanus Muhl.
Lobelia syphilitica L.
Senecio aureus L.
Eupatorum perfoliatum L.
Eupatorum maculatum L.

Several species of the Tall-grass Prairie Center are particularly evident in the flora of the raised bog. Among them are the following:

Andropogon furcatus (Muhl.)
Andropogon scoparius Michx.
Sorghastrum nutans (L.) Nash.
Filipendula rubra (Hill.) Rob.
Apocynum cannabinum L.
Koellia virginiana (L.) MacM.
Solidago ohioensis Ridd.
Allium cernuum Roth.
Steironema quadriflorum (Sims.) Hitchc.
Meibomia canadensis (L.) Ktz.
Mesadenia tuberosa (Nutt.) Britt.
Silphium trifoliatum L.
Rudbeckia hirta L.
Liatris spicata (L.) Willd.

In the swampy fields below and surrounding the raised bog a number of other interesting marsh species may be found, such as the following:

Valeriana edulis Nutt.
Lathyrus palustris L.
Triglochin maritima L.
Parnassia caroliniana Mx.
Solidago riddellii Frank.
Lobelia kalmii L.

A few weedy species also grow among the bog shrubs, among them the following:

Barbarea stricta Andrz.
Cerastium vulgatum L.
Nepeta hederacea (L.) Trevisan.
Convolvulus sepium L.
Dipsacus sylvestris Huds.
Erigeron ramosus (Walt.) B. S. P.
Asclepias syriaca L.
Parthenocissus quinquefolia (L.) Planch.
Leontodon taraxacum L.
Cirsium arvense (L.) Scop.
Lactuca canadensis L.

The origin of the raised bog at Urbana can be clearly understood only if we take into account some important historical factors. An early continental glacier (Wisconsin?) invaded the Urbana region. Two main lobes of the glacier, the Miami lobe to the west and the Scioto lobe to the east, were formed by the Campbell Hill promontory ten miles north of Urbana. The ice must have stagnated there for a long time, because deep deposits of gravel and boulders compose the lateral moraines on either side of the Mad River Valley. These deposits serve as

reservoirs of water and form the principal source of headwaters in the Mad River drainage.

The glacial drift at Urbana overlies limestone to a depth of 150 feet (Leverett, 1902). Land 1.7 miles east of the raised bog rises 130 feet higher than the margins of the bog, in a region of kame topography. Flowing wells or artesian springs are found in several places. It was around one of these artesian springs that the raised bog at Urbana developed. Supported by hydrostatic pressure below and held together by a mass of roots above, the bog shrub association of *Dasiphora fruticosa* exists here as a relic of an earlier type of vegetation which once occurred throughout the region. In spite of present climatic conditions, the constancy of water supply from artesian sources has maintained alkaline bog vegetation in a region where the prevailing natural vegetation is oak-hickory forest and tall-grass prairie.

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Geology of California.

To completely cover the geology of California in one volume is impossible. Reed has wisely touched only on the pre-Mesozoic geology and expended most of his labor on attempting to explain and clarify the geology from the base of the Triassic on, with especial emphasis on the Tertiary. This would appear to be an extremely wise course to take especially as his profession (Chief Geologist of the Texas Oil Company of California) has so ably fitted him to explain the complicated and often poorly correlated and identified Tertiary rocks of California. The work is enhanced with paleogeographic maps of the various periods from the Cretaceous to the recent. An appendix of important geographic names, an authors index, and a subject index are supplied. The use of the term "microphotograph" for photomicrograph is unfortunate but still a common usage. It is to be regretted that a fairly large scale geologic map could not be included as it would be of great value.—WILLARD BERRY.

Geology of California, by R. D. Reed. xxiv+355 pp. Tulsa, American Association of Petroleum Geologists, 1933.